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Research Article

The first record of *Atherigona* from Lesotho (Diptera, Muscidae), with description of a new species

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Abstract

Eight species of *Atherigona* Rondani, 1856 are recorded from Lesotho for the first time: *Atherigona angulata* Deeming, 1971, *Atherigona chrysohypene* Muller, 2015, *Atherigona kirkspriggsi* Muller, 2015, *Atherigona laevigata* (Loew, 1852), *Atherigona lineata ugandae* van Emden, 1940, *Atherigona londti* Muller, 2015, *Atherigona rubricornis* Stein, 1913 and a new species *Atherigona jordaensi* **sp. nov.** The new species is described and diagnoses for all known species from Lesotho are provided with a brief discussion on their distribution in the country.

Key words: Afrotropical Region, new records, shoot flies, Southern Africa, taxonomy

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Introduction

Atherigona Rondani, 1856 is one of the most speciose genera of Muscidae, with some 260 species described, of which ca 168 species are known to occur in the Afrotropical region (Dike 2003; Couri et al. 2006; Muller 2015; Muller and Mostovski 2018; Deeming 2019; Deeming 2022). The identification key to Afrotropical Muscidae by Couri (2007) can be used to reliably identify the genus within the Region. It consists of two subgenera, *Atherigona sensu stricto* and *Atherigona* (*Acritochaeta*) Grimshaw, 1901 (Suh and Kwon 2018). *Atherigona s. str*. attacks cultivated crops; the larvae feeding mostly on Poaceae which includes several cereal crops (Suh and Kwon 2018). *Atherigona tritici* Pont & Deeming, 2001, *Atherigona naqvii* Steyskal, 1966 and *Atherigona lineata* (Adams, 1905) have been reported to cause harm to cereal crops, with *A. tritici* resulting in about 10% wheat yield loss (Pont and Deeming 2001; Muller and Mostovski 2018). *Atherigona soccata* Rondani, 1871, better known as the sorghum shoot fly is one of the most notorious pest species known to occur in Africa. It causes dead heart symptoms, especially in sorghum, but also millet and maize (Van den Berg et al. 2005). It is widespread and infestations have resulted in up to 90% yield loss across Africa, Asia and, Latin America (Young and Teetes 1977; Sherwill et al. 1999; Muller and Mostovski 2018).

The larvae of *Atherigona* (*Acritochaeta*) species, in contrast, are typically considered saprophages or facultative predators in decaying organic matter (Skidmore 1985; Grzywacz et al. 2013); additionally Kovac et al. (2023)

described *Atherigona* (*Acritochaeta*) *culicivora* Kovac, Pont & Deeming, 2023 from Thailand that is subaquatic and preys on mosquito larvae. In contrast, *Atherigona* (*Acritochaeta*) *orientalis* Schiner, 1868, is a pest of agricultural crops such as peppers, tomatoes, and sorghum (Savage 2016; Roditakis et al. 2023).

The Diptera of Lesotho are generally poorly studied and Midgley et al. (2023) provided a summary of the history of collecting in Lesotho, as well as detailed information on recent collecting trips. This collecting paucity is further emphasized by papers such as Muller and Midgley (2022) where they report on the first record of a similarly speciose genus *Coenosia* Meigen, 1826 from Lesotho. *Coenosia* is quite well known from the surrounding South Africa, yet conversely the genus was unrecorded for Lesotho. This holds true for *Atherigona* and most other muscid genera.

Although Lesotho shares much of its vegetation (Mucina and Rutherford 2006) and geology with South Africa, it is on average 900 metres higher above sea level than South Africa (Midgley et al. 2023), and this difference in elevation compared to South Africa may result in differences in insect diversity. As insect pests, *Atherigona* species may potentially contribute to agricultural challenges in Lesotho. However, more information on the diversity and distribution of the genus is needed before potential management practices may be implemented. This could allow local subsistence farmers and land managers to better manage pest species if present. To this end, a species checklist of newly recorded *Atherigona* is provided, with a description of *A. jordaensi* sp. nov., from southeastern Lesotho. This should be seen as a springboard to the future study of the group in Lesotho.

Material and methods

Collection abbreviations (Curators in parentheses)

AMGS Albany Museum, Makhanda, South Africa (Terence Bellingan);
BMSA National Museum, Bloemfontein, South Africa (Gimo Daniel);
NMSA KwaZulu-Natal Museum, Pietermaritzburg, South Africa (Kirstin Williams).

Locality and collecting methods

Specimens were collected either by hand using a sweep net or through Malaise trapping. Specimens were examined from 8 sites: 5 Lesotho Highland Basalt Grassland sites and 1 Western Lesotho Basalt Shrubland site within the Drakensberg Grassland Bioregion, and 2 Basotho Montane Shrubland site within Mesic Highveld Grassland Bioregion (Figs 1, 2).

Specimen treatment

Male terminalia were macerated in 10% heated potassium hydroxide (KOH) for approximately 10 minutes and the trifoliate process (Figs 4–11) exposed. Specimens were identified using a combination of the keys provided by Dike (1989) and Muller (2015). All measurements of *A. jordaensi* sp. nov., were made using a Nikon SMZ745T stereomicroscope with attached Motic camera and Motic Images Plus 3 software. The habitus photo of *A. jordaensi* sp. nov. was taken using a Canon 850D camera, and illustrations of terminalia made using a combination of Adobe Illustrator and Photoshop CC 2024.

Figures 1, 2. Sampling localities and vegetation examples **1** roadside swamp, 30°13.690'S, 28°8.445'E, Lesotho Highland Basalt Grassland (*A. jordaensi* sp. nov. type locality) **2** near Molimo Nthuse Lodge, on God Help Me Pass, A3, 29°25.386'S, 27°54.330'E, Western Lesotho Basalt Shrubland. (Fig. 1: Midgley et al. 2023, p215, fig. 27).

Taxonomy

Genus *Atherigona* Rondani, 1856
Subgenus *Atherigona* Rondani, 1856

***Atherigona angulata* Deeming, 1971**
Fig. 4

Atherigona angulata Deeming, 1971: 157, figs 54, 55; Deeming 1981: 105; Muller 2015: 858, fig. 5.

Material examined. LESOTHO • 2♂; Mamathes [now Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 30 Apr. 1949; C. Jacot Guillarmod leg. (AMGS) • 1♂; Masupha, Basutoland; [29°8.000'S, 27°51.000'E]; 10 Jun. 1948; C. Jacot Guillarmod leg. (AMGS) • 1♂; Mamathes, Basutoland; [29°8.000'S, 27°51.000'E]; 8 Feb. 1948; C. Jacot Guillarmod leg. (AMGS).

Other material examined. SOUTH AFRICA • 1♂; Free State, Brandfort, Florisbad Research Station; 28°46.039'S, 26°04.234'E; 4–6 Apr. 2009; A.H. Kirk-Spriggs leg.; Malaise traps, Acacia, Savanna; BMSA(D)05575 • 1♂; Free State, Brandfort, Soetdoring Nature Reserve, train camp; 28°50.934'S, 26°01.996'E; 5–6 Apr. 2009; A.H. & M.K. Kirk-Spriggs leg.; Malaise traps, Acacia, Savanna thicket; BMSA(D)05494.

Diagnosis. This species has golden/yellow vibrissa, similar to that of *Atherigona pulla* (Wiedemann, 1830) and *Atherigona chrysohypene* Muller, 2015. It can be distinguished from *A. pulla* by the shape of the trifoliate process, with the median piece bent at a right-angle when viewed in profile (Fig. 4b) compared to a linear median piece in *A. pulla*. It can be distinguished from *A. chrysohypene* by the shape of the hypopygial prominence which is knoblike (Fig. 4) and with an apical emargination, compared to that of *A. chrysohypene* which is bilobate (Fig. 5).

Distribution. Botswana, Lesotho (new record), Namibia, Nigeria, South Africa, Saudi Arabia.

***Atherigona chrysohypene* Muller, 2015**
Fig. 5

Atherigona chrysohypene Muller, 2015: 863, fig. 46.

Material examined. LESOTHO • 4♂; Mamathes [Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 16 May 1948; C. Jacot Guillarmod leg. (AMGS) • 1♂; Masupha, Basutoland; [29°8.000'S, 27°51.000'E]; 24 May 1948; C. Jacot Guillarmod leg. (AMGS) • 1♂; Mamathes [Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 30 May 1948; C. Jacot Guillarmod leg. (AMGS) • 2♂; Mamathes [Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 10 Jun. 1948; C. Jacot Guillarmod leg. (AMGS).

Diagnosis. This species is similar to *A. pulla* and *A. angulata* due to its golden yellow vibrissa. However, it can be distinguished from both by its bilobate hypopygial prominence (Fig. 5), while *A. pulla* and *A. angulata* have the hypopygial prominence knoblike (e.g. Fig. 4).

Distribution. Lesotho (new record), South Africa.

***Atherigona jordaensi* sp. nov.**
https://zoobank.org/C6F47D05-FC8D-4B09-B51C-CFDADBBCC098
Figs 3, 6

Material examined. Type material examined: *Holotype*: LESOTHO • 1♂; Quting, Mphaki, Roadside swamp; 30°13.690'S, 28°8.445'E; 30 Nov. 2022; K. Jordaens, J. Midgley, B. Muller and G. Theron leg.; Hand collecting; Lesotho Highland Basalt Grassland; BMSA(D)134684. The holotype is in good condition. Paratypes: LESOTHO • 2♂; Same data as holotype; (BMSA(D)134681; NMSA DIP 223216) • 3♂; Quting, Mphaki, Roadside seep/stream; 30°12.882'S, 28°8.307'E; 2221 m; 28–30 Nov. 2022; K. Jordaens, J. Midgley, B. Muller and G. Theron leg.; Hand collecting; Lesotho Highland Basalt Grassland; (BMSA(D)134678, 134675; NMSA-DIP 223217) • 2♂; Maseru District, God Help Me Pass, A3, nr, Molimo Nthuse Lodge; 29°25.386'S, 27°54.330'E; 2025 m; 29 Jan. 2023; B.S. Muller And G. Theron leg.; Sweep net, Mixed Forest vegetation; (BMSA(D)132581; NMSA-DIP 223218) • 1♂; Quting, Letseng la Letsie at; 30°18.772'S, 28°10.062'E; 2410 m; 29 Nov. 2022; K. Jordaens, J. Midgley, B. Muller and G. Theron leg.; Hand collecting, Lesotho Highland Basalt Grassland; BMSA(D)134693.

Other material examined. SOUTH AFRICA • 2♂; Free State, Harrismith, Scotland farm at: 27°58.992'S, 29°37.151'E; 10–12 Nov. 2009; A.H. Kirk-Spriggs leg.; Malaise traps, dense *Leucosedea*-dominated scrub; (BMSA(D)12781, 12783).

Type condition. The following 7♂ paratypes were dissected: BMSA(D)134681, 134680, 134678, 134675, 134674, 132581, 134693.

Deposition information. Holotype and paratypes are deposited at National Museum, Bloemfontein, except for NMSA-DIP 223216, 223217, 223218 that are deposited at the KwaZulu-Natal Museum.

Diagnosis. This species is most similar to *Atherigona decempilosa* Dike, 1989. It will key out to couplet 30 in Muller (2015). It can be separated from *A. decempilosa* by having the median piece of the trifoliate process medially dilated in profile (Fig. 6) not "apically dilated and bifid" and the basal lateral area of the lateral plates curve upward and do not appear "angular". Additionally, the

Figure 3. Photo of *Atherigona jordaensi* sp. nov. Holotype male. Scale bar: 1 mm.

hood of *A. jordaensi* is not as well-developed as in *A. decempilosa* (Muller 2015, fig. 25). Lastly, *A. decempilosa* has some degree of infuscation on all of its legs whereas *A. jordaensi* only has the foreleg somewhat infuscated.

Description. Measurements (Holotype): Body length: 3.84 mm wing: 3.66 mm, rm crossvein ratio: 0.375.

Male. *Head*: Ground colour dark; all head setae and setulae infuscated; upper occiput grey dusted posteriorly with narrow median part glossy, laterally also grey dusted, however, lower occiput golden-grey dusted; ocellar triangle grey dusted; with three pairs of strong proclinate frontal setae and two weaker and shorter setae on frontal angle, also with two pairs of orbital setae; parafacial silver-grey dusted, at narrowest as wide as aristal base; scape and pedicel entirely infuscated; postpedicel infuscated; arista infuscated; palpus infuscated, apically dilated and truncated, with some short infuscated setulae and mostly longer hyaline setulae; four well-developed vibrissal setae surrounded by 3–4 setulae.

Thorax: Ground colour dark; postpronotal lobe grey dusted, lobe with three setae and 8–14 setulae; scutum golden-grey dusted, with faint 2–4 dorsocentral vittae, not extending to the scutellum; scutellum golden-grey dusted dorsally, margins more densely golden-grey dusted; one pair of basal setae, one pair of discal setae and 3–8 discal setulae, one pair of subbasal setae and one pair of apical setae, subbasal and apical pair subequal; pleura golden-grey dusted; proepisternum inconspicuous, with two setae, one stronger than the other, and one setula (some specimens with an additional much weaker setula); katepisternal setae 1:1:1.

Legs: All legs yellow except for apical half of fore femur, excluding apex, apical 2/3 of fore tibia and fore tarsi that are infuscated; leg chaetotaxy: fore tarsi without any specialised chaetotaxy.

Wings: Hyaline; veins light-brown; halteres with white knob and yellow stalk; calypters somewhat light-brown.

Abdomen: All tergites and sternites yellow and without any dorsal median vittae; tergite 1+2 immaculate; tergite 3 with two small spots (some specimens appearing to have a large mark underneath each spot), ca 2× the size of those on tergite 4; tergite 4 also with two small spots; tergite 5 immaculate.

Terminalia (Fig. 6): Hypopygial prominence knob-shaped with two anteriorly projecting tubercles. Trifoliate process infuscated except for brown stem; median piece of the trifoliate process medially dilated in profile; lateral plates wider than median piece in profile, inner lobes present. Surstylus not infuscated.

Female. Unknown

Etymology. Named after Dr Kurt Jordaens of the Royal Museum for Central Africa, Tervuren, for his contribution to the study of Diptera in Lesotho.

Distribution. Lesotho, South Africa.

Atherigona kirkspriggsi Muller, 2015

Fig. 7

Atherigona kirkspriggsi Muller, 2015: 875, fig. 33.

Material examined. LESOTHO • 17♂; Leribe District, Motebong Lodge, Katse Dam area; 29°6.060'S, 28°30.084'E; 2063 m; 10–13 Dec. 2021; J.M. Midgley, B. Muller leg.; Malaise trap, Garden entertainment area; (BMSA(D)130773, 130775, 130776, 130777, 130778, 130779, 130783, 130809, 130810, 130826,130844, 130848, (NMSA-DIP 213809, 213810, 213812, 213813, 213814)) • 1♂; Quting, Mphaki Farmers Training Centre; 30°11.598'S, 28°7.831'E; 2046 m; 01–27 Nov.– Dec. 2022; K. Jordaens, J. Midgley, B. Muller and G. Theron leg.; Malaise trap, Lesotho Highland Basalt Grassland, Garden; BMSA(D)134687.

Diagnosis. This species is similar to *Atherigona lineata torrida* Deeming, 1971. However, it differs from it by having a tridentate hypopygial prominence (Fig. 7) and infuscated mid and hind leg tarsi, compared to the bifurcated hypopygial prominence and brown tarsi in *Atherigona lineata lineata* (Adams, 1905).

Distribution. Lesotho (new record), South Africa.

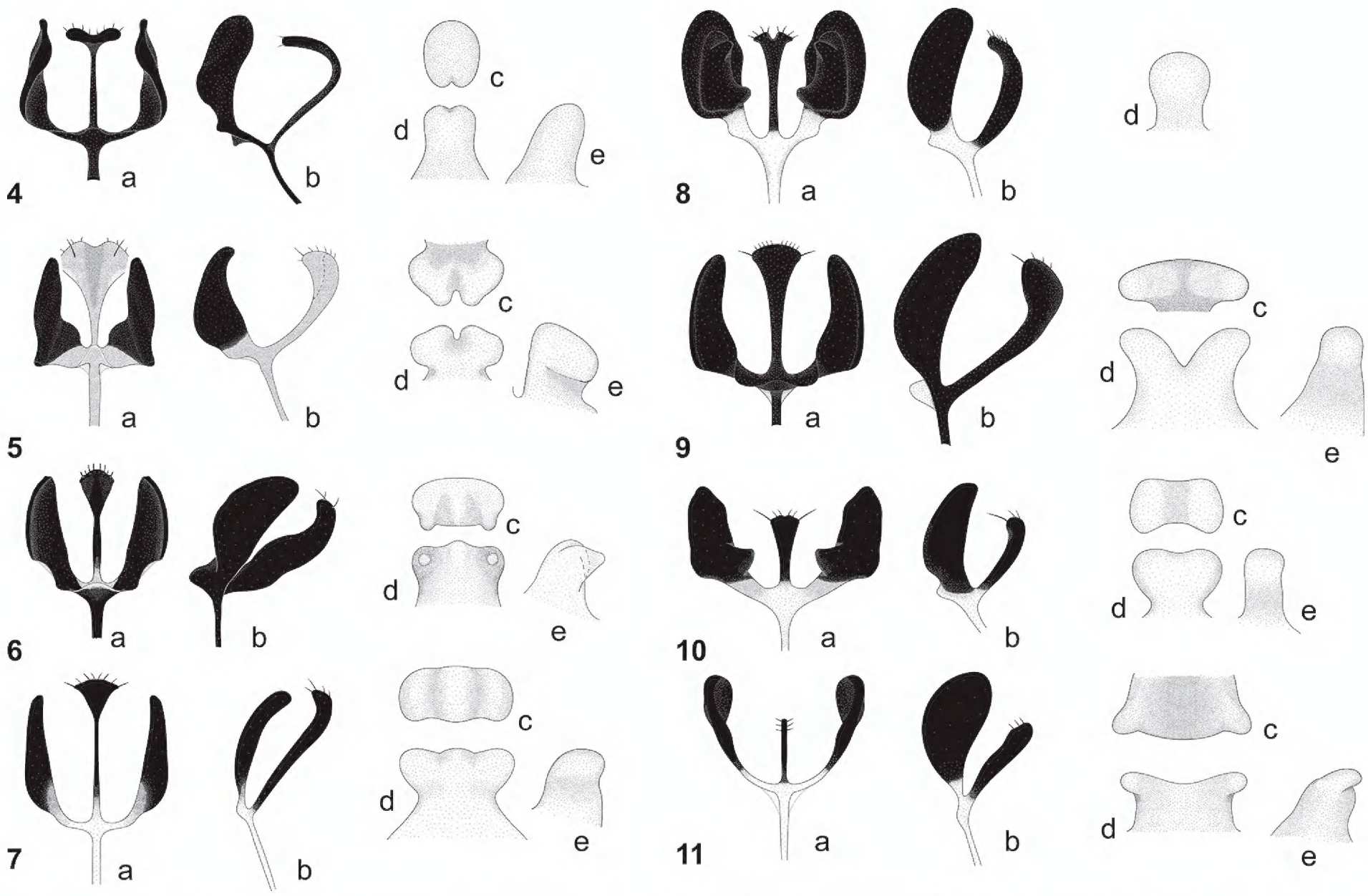
Atherigona laevigata (Loew, 1852)

Fig. 8

Coenosia laevigata Loew, 1852: 660.
Atherigona laevigata: Van Emden 1940: 113, figs 6, 56; Deeming 1971: 148, figs 13–18; Pont 1991: 341; Muller 2015: 877, fig. 7, Muller and Mostovski 2018: 350, fig. 6, Deeming 2022: 127.
Atherigona scutellaris Stein in Becker 1903: 110.
Atherigona minuta Schnabl & Dziedzicki, 1911: 183.

Material examined. LESOTHO • 1♂; Mamathes [Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 16 May 1948; C. Jacot Guillarmod leg.

Other material examined. SOUTH AFRICA • 1♂; Free State, Brandfort, Florisbad Research Station; 28°46.039'S, 26°04.234'E; 4–6 Apr. 2009; A.H. Kirk-Spriggs leg.; Malaise traps, Acacia, Savanna; BMSA(D)05529 • 1♂; KwaZulu-Natal,



Figures 4–11. Trifoliate process and hypopygial prominence of **4** *A. angulata* **5** *A. chrysohypene* **6** *A. jordaensi* sp. nov. **7** *A. kirkspriggsi* **8** *A. laevigata* **9** *A. lineata ugandae* **10** *A. londti* **11** *A. rubricornis.* Trifoliate process: **a** posterior view **b** in profile. Hypopygial prominence **c** dorsal view **d** posterior view **e** in profile.

Ndumo Game Reserve, Shokwe area at: 26°52.125'S, 32°13.731'E; 30 Nov.–4 Dec. 2009; A.H. Kirk-Spriggs leg.; Malaise traps, Ficus forest; BMSA(D)15826.

Diagnosis. This species can be distinguished from other Afrotropical species by its glossy frontal plate and infuscated frontal vitta with apical third yellow in combination with a knoblike hypopygial prominence (Fig. 8).

Distribution. AFROTROPICAL – Angola, Comoros, Democratic Republic of Congo, Ethiopia, Kenya, Lesotho (new record), Madagascar, Mali, Mauritius, Mozambique, Namibia, Nigeria, Rwanda, Seychelles, South Africa, Tanzania, Uganda, Zambia, Zimbabwe. PALAEARCTIC – Cyprus, Egypt, Iraq, Israel, Jordan, Saudi Arabia, UAE, Yemen.

Atherigona lineata ugandae van Emden, 1940

Fig. 9

Atherigona lineata ugandae van Emden, 1940: 137, figs 18, 39. Deeming 1971: 177, figs 134–138; Deeming 2000: 285; Muller 2015: 882, fig. 53.

Material examined. LESOTHO • 3♂; Mamathes [Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 16 May 1948; C. Jacot Guillarmod leg.

Other material examined. SOUTH AFRICA • 2♂; Free State, Brandfort, Florisbad Research Station; 28°46.039'S, 26°04.234'E; 4–6 Apr. 2009; A.H. Kirk-Spriggs leg.; Malaise traps, Acacia, Savanna; (BMSA(D)05530, 05590).

Diagnosis. *Atherigona lineata* and its subspecies can be distinguished from other similar species by the combination of an infuscated frontal vitta and palpus, and a bifurcated hypopygial prominence. The subspecies *A. lineata lineata*, *A. lineata torrida*, and *A. lineata ugandae* can be distinguished from one another based on the following: *A. lineata lineata* and *A. lineata torrida* have the fore femur infuscated on at least the apical third (the fore femur of *A. lineata ugandae* is entirely yellow). Additionally, the shape of the lateral lobes of the trifoliate process and the depth of the bifurcation of the hypopygial prominence differs in these two subspecies. *A. lineata ugandae* has the hood area of the trifoliate process infuscated (hyaline for the other two) and has a much deeper, wider and pronounced bifurcation compared to others (Fig. 9).

Distribution. Angola, Botswana, Chad, Ethiopia, Kenya, Lesotho (new record), Malawi, Mali, Namibia, Nigeria, Rwanda, South Africa, Uganda.

***Atherigona londti* Muller, 2015**
Fig. 10a–e

Atherigona londti Muller, 2015: 882, fig. 48.

Material examined. LESOTHO • 2♂; Leribe, Motebong Lodge, Katse Dam area; 29°6.060'S, 28°30.084'E; 2063 m; 10–13 Dec. 2021; J.M. Midgley and B. Muller leg.; Malaise trap, Garden entertainment area; (BMSA(D)130774, NMSA-DIP 213800). 3♂; Maseru, Roma Trading Post Lodge; 29°26.592'S, 27°42.224'E; 1640 m; 24–27 Nov. 2022; K. Jordaens, J. Midgley, B. Muller and G. Theron leg.; Malaise trap, Basotho Montane Shrubland, Garden; (BMSA(D)134689,134691,134690).

Diagnosis. This species' scutellum is similar to *Atherigona flavifinis* Muller, 2015 (fig. 16 in Muller 2015) and *Atherigona latibasilaris* Muller, 2015 (fig. 40 in Muller 2015) in having the apex of the scutellum yellow. However, the trifoliate process and hypopygial prominence differ greatly. It keys close to *Atherigona hyalinipennis* van Emden, 1959 and *Atherigona secrecauda* Séguy, 1938 using the keys provided by Deeming (1971) and Dike (1989) but the trifoliate process (Fig. 10) of *A. londti* does not have the wing-like projections of the hood present as in *A. secrecauda*, nor does it have the cordiform median piece of *A. hyalinipennis*.

Distribution. Lesotho (new record), South Africa.

***Atherigona rubricornis* Stein, 1913**
Fig. 11a–e

Atherigona rubricornis Stein, 1913: 531; van Emden 1940: 101, figs. 15, 51; Deeming 1971: 157, figs 47, 48 (*A. tritici* Pont & Deeming figured); Deeming 1979: 39, figs 19 (female tergite 8); Pont and Deeming 2001: 298, figs 1–4; Muller 2015: 897, fig. 38.

Material examined. LESOTHO • 1♂; Mamathes [Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 30 Apr. 1949; C. Jacot Guillarmod leg. • 1 ♂; Mamathes [Masupha], Basutoland; [29°8.000'S, 27°51.000'E]; 10 Jun. 1948; C. Jacot Guillarmod leg.

Other material examined. SOUTH AFRICA • 1♂; Free State, Brandfort, Florisbad Research Station; 28°46.039'S, 26°04.234'E; 4–6 Apr. 2009; A.H. Kirk-Spriggs leg.; Malaise traps, Acacia, Savanna; BMSA(D)05581 • 1♂; KwaZulu-Natal, Royal Natal National Park, Thendele; 28°42.378'S, 28°56.083'E; 15–17.ii.2010; A.H. Kirk-Spriggs leg.; Malaise traps, *Leucosedea*-dominated scrub; BMSA(D)19723.

Diagnosis. This species is similar to *A. tritici* (which was previously regarded as a form of *A. rubricornis*), but *A. tritici* differs from it by having a median piece with a dilated apical appearance in profile. *Atherigona rubricornis* can be distinguished from other species by its partially yellow frontal vitta and the trifoliate process with median piece linear in posterior view (Fig. 11).

Distribution. Botswana, Chad, Kenya, Lesotho (new record), Namibia, Nigeria, South Africa, Uganda, Zimbabwe.

Discussion

Atherigona is abundant throughout southern Africa and is especially well-recorded and known in South Africa (Muller 2015). Its marked abundance coupled with the lack of previous records from Lesotho highlight the need for more rigorous sampling in order to get a more complete picture of the diversity of the group within the country. Neither *A. soccata* nor *A. orientalis*, known pest species, have been recorded from Lesotho as yet, but the recent expeditions to Lesotho (e.g. Midgley et al. 2023) were more focussed on Alpine areas and less disturbed natural areas, with only 8 out of 30 collecting sites yielding *Atherigona*. To truly record the diversity of *Atherigona* in Lesotho, future surveys will have to be expanded to more *Atherigona*-focussed sampling sites and especially disturbed areas. One would also have to involve local authorities and collaborate with local commercial and subsistence farmers and their surroundings.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

MMJM confirms ethical clearance, number NMB ECC 2024/04, forming part of project 567 of the National Museum, Bloemfontein, South Africa.

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Author contributions

M.M.J. Magoai conceptualised the project with inputs from B.S. Muller. Magoai identified, described and revised the species, and wrote the first draft of the manuscript. Muller illustrated and photographed specimens, and commented and made additions to the final draft.

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Data availability

All of the data that support the findings of this study are available in the main text.

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